Air Force Materiel Command

One Materiel Command

Environmentally Advantaged Powder Coatings for Aerospace Applications

ESTCP PROJECTS
WP-0614 & WP-0801

Presented at: SERDP/ESTCP Workshop – Surface Finishing and Repair Issues for Sustaining New Military Aircraft

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Overview

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Why Powder Coat?

- **Eliminates VOCs**
- **Eliminates HAPs**
- **Eliminates Hazardous Waste**
  - Solvent free material – no pot life limitations
- **Reduction of ESOH Concerns**
  - Human Health & Environment
- **Improved Process Efficiency**
  - Quicker cure time
  - Quicker equipment prep and clean-up
  - Improved transfer efficiencies
    - High as 95% versus 50 – 60% for wet paint

Why Not Powder Coat?

- **Previous way of thinking about powder:**
  - High processing temperature
    - High preheat temperatures – as high as 675°F
    - High cure temperatures – typically as high as 428°F
    - Prohibits use on many common alloys – Al, MG
  - No corrosion protection once barrier protection compromised

- **Today's material eliminates these limitations**

LTCPC Material

- **Developed by GE Global Research, Crosslink Powder and DoD Labs with SERDP funding**
- **Program Results - developed a viable low temperature cure coating**
  - Coating cures at 250°F within 30 minutes
  - Corrosion protection
    - Corrosion inhibitor package - barium metaborate
    - Leachable corrosion protection
    - Comparable to conventional solvent borne organic coatings
    - Eliminates need for primer

LTCPC Material

- **Material Advantages**
  - SERDP material met all military ground support equipment requirements for durability, toughness, chemical resistance, gloss, and surface quality
- **Coating met all target performance requirements**
  - Chemical strippability confirmed
  - Cleanability verified using QPL cleaners
  - Complete field repair evaluation verified
  - Weathering and filiform corrosion tests substantiated
- **The Final Product**
  - Acid functional polyester resin and catalyst with triglycidylisocyanurate (TGIC) crosslinker and a barium metaborate type corrosion inhibitor package

ESTCP LTCPC Project (WP-0614)

Taking the LTCPC to the Next Level - Transitioning to the field

This is occurring through an ESTCP funded effort.

Primary Performers/Stakeholders:

- Air Force Corrosion Office (AFCO)
- Air Force Material Command (AFMC)
- Air Logistics Centers - OC-ALC, OO-ALC, WR-ALC
- Concurrent Technologies Corporation (CTC)
- Crosslink Powder Coatings
- Joint Group on Pollution Prevention (JG-PP)
- National Aeronautics and Space Administration (NASA)
- Propulsion Environmental Working Group (PEWG)
- Science Applications International Corporation (SAIC)
- U.S. NAVY

Substrate Test Summary

WP-0614 LTCPC JTP Test Results

Substrate	Appearance	Salt Spray	SO2	Cyclic	Filiform	Adhesion	Impact	Strip	Immersion	Humidity	Gravel	Low T Flex
4130 steel	SAME	SAME	SAME	SAME	--	SAME	--	Note 3	--	--	--	--
2024-T0 Al	SAME	--	--	--	--	--	Note 2	--	--	--	--	Pending
2024-T3 Al (CCC)	SAME	SAME	SAME	--	--	--	--	--	Note 2	Note 2	--	--
2024-T3 Al (No)	SAME	LESS	LESS	--	--	--	--	--	Note 2	Note 2	Note 2	--
6060-T6 Al (CCC)	SAME	SAME	SAME	--	--	--	--	--	--	--	--	--
6060-T6 Al (No)	SAME	LESS	LESS	--	--	--	--	--	--	--	--	--
2024-T3 Clad (CCC)	SAME	SAME	--	BETTR	Note 1	--	--	--	--	--	--	--
2024-T3 Clad (No)	SAME	LESS	--	SAME	Note 1	--	--	--	--	--	--	--
6061-T6 Al (CCC)	SAME	SAME (note 4)	SAME	--	--	SAME	--	Note 3	--	--	--	--
6061-T6 Al (PK)	SAME	SAME (note 4)	LESS	--	--	SAME	--	Note 3	--	--	--	--
AZ31B Mg (Dow)	SAME	SAME	--	--	--	SAME	--	Note 3	--	--	--	--

Legend: LESS=Less than control SAME=Same as control BETTR=Better than control

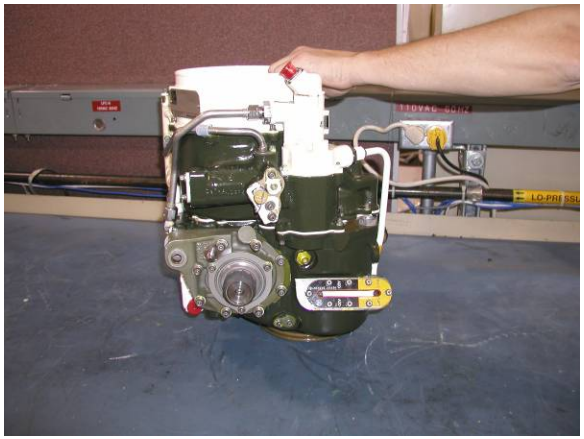
Note 1: Marginal - Some filiments were up to 0.28 inch.
Note 2: Met requirements in the JTP.
Note 3: Non methylene chloride stripper effective.
Note 4: Exceeded 3300 hrs in salt spray

LTCPC Application Areas

Propulsion systems

LTCPC Application Areas

Non outer mold line components



LTCPC Application Areas

Aerospace Ground Equipment (AGE)

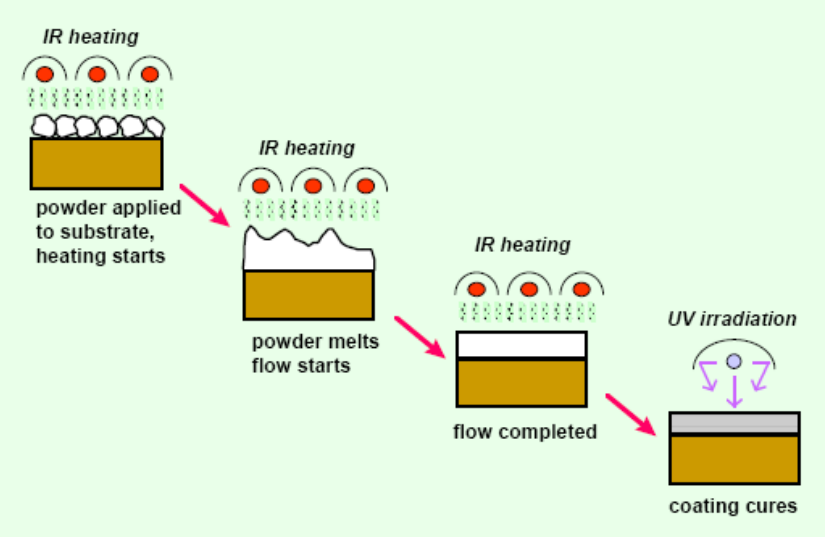
UV-Curable Powder Coatings (WP-0801)

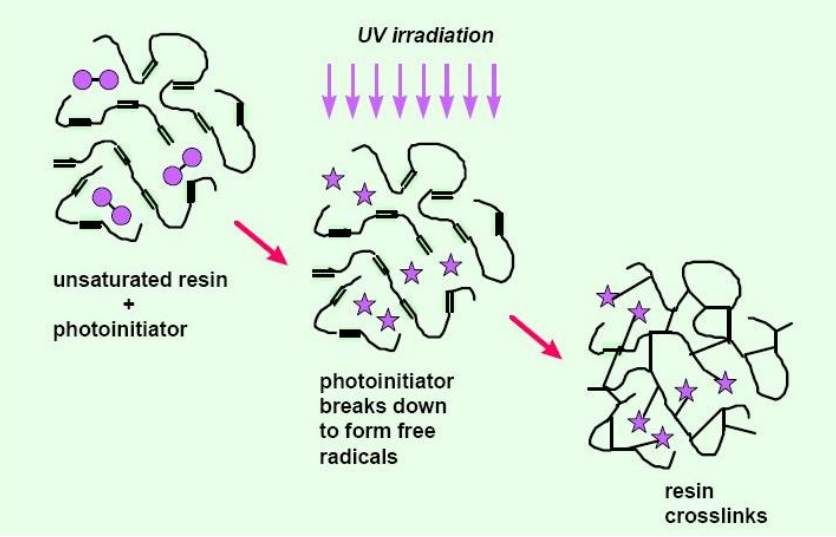
- **Objectives:**
  - Demonstrate a VOC/HAP-free, Ultraviolet cure powder coating on DoD depot production hardware to replace solvent-borne organic coatings
  - Demonstrate state-of-the-art robotic curing
  - Verify environmental and economic advantages relative to current solvent-borne technology
  - Validate that UV-cure powder is better in terms of cost, schedule, and performance

UV-Curable Powder Coatings

Technology Description:

- UV-cure powder is an acrylated polyester and polyurethane blend, containing corrosion inhibitor, pigments, photoinitiators, and other constituents
- Powder melts under Infrared heat - as low as 175°F
- The powder is then cured in 5 – 10 seconds using 600W/in Gallium doped UV lamps.





UV-Curable Powder Coatings

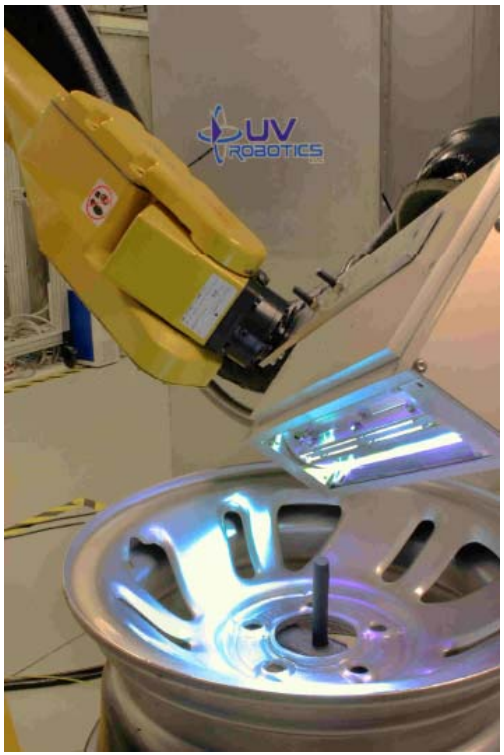
Technology Description (cont):

- Reduced thermal exposure enables coating of temperature sensitive components
- Enables large bulky parts to be coated that won't fit into existing curing ovens
- Robotics for melting/curing allows complex shapes such as wheels to be powder coated with improved quality
- UV-cure powder is faster to apply and cure resulting in reduced turnaround times
- UV-cure powder lowers utility cost through reduced cure times (seconds) and elimination of conventional ovens

UV-Curable Powder Coatings

Technology Maturity:

- The first UV-cure powder coating line was opened in 1998 and is still running.
- UV-cure robotics are currently coating and UV-curing automotive wheels and other parts.



UV-Curable Powder Coatings

Candidate components for UV-cure powder

Internal Components

Aircraft and aircraft composites

Landing gear

Ground Support Equipment

Aircraft wheels

Summary

- **Traditional high-temp powder coatings were not well suited for aerospace applications**
  - Processing temperatures too high (428°F to 675°F)
  - Provided limited barrier protection (coating only)
- **Powder coating advancements**
  - Low temperature curable powder (as low as 175°F)
  - Ultraviolet curing
  - Corrosion inhibitor packages
- **Powder coatings show promise over wet coatings**
  - Eliminates toxic and hazardous materials from process
  - Reduces labor and utility cost
  - Improves quality, reliability, maintainability, & supportability

Questions?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WAR-WINNING SYSTEMS
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